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# Economic Impact Analysis

Community Relations and Technology Transfer  
Directorate  
Ernest Orlando Lawrence Berkeley National Laboratory  
University of California  
Berkeley, CA 94720  
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# Executive Summary

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With an annual budget of over \$340 million and a workforce that exceeds 3,300, the Ernest Orlando Lawrence Berkeley National Laboratory has a significant economic impact on the San Francisco Bay Area and the nation. Berkeley Lab is the second largest employer in Berkeley and the twelfth largest in Alameda County. Nearly 2,000 (60%) of Berkeley Lab's workers live in Alameda County, and another 1,000 (30%) reside in Contra Costa County. Over 1,500 Lab retirees and survivors receive pension benefits. The Lab is a major customer of numerous small businesses and contractors, expending nearly \$100 million dollars for goods and services during Fiscal Year 1995. Berkeley Lab annually hosts thousands of visitors who use its facilities or attend Lab-sponsored conferences. Altogether, Berkeley Lab estimates its total quantifiable direct economic impact to be \$400 million annually.

Beyond payroll and procurement, Berkeley Lab's direct payments are re-spent in the local and greater economy. Employees and contractors spend their salaries or payments at businesses for personal goods and services. When this re-spending effect is considered, Berkeley Lab estimates that its direct, indirect, and induced economic impact on the Bay Area output is \$549 million. Further, the Lab estimates that it has a total regional employment impact of at least 3,800 jobs. Unique user facilities attract an estimated 1,700 visiting scientists each year, bringing in more than \$340,000 annually. The Lab's technology transfer efforts, particularly in the area of energy efficiency, have also created new business opportunities and start-up companies, saved consumers money, and improved national industrial competitiveness.

While these impacts are impressive, not all of Berkeley Lab's contributions to the community and the nation can be measured simply in dollars and cents. For example, Lab staff is involved in numerous community outreach activities, such as education, emergency response to fire and natural disaster, mass transit, and various volunteer and professional activities.



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# Acronyms

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|        |  |
|--------|--|
| ABAG   | Association of Bay Area Governments                    |
| CAD    | Computer-Aided Design                                  |
| CFC    | Combined Federal Campaign                              |
| CIEE   | California Institute for Energy Efficiency             |
| CRADA  | Cooperative Research and Development Agreement         |
| CSEE   | Center for Science and Engineering Education           |
| DOE    | U.S. Department of Energy                              |
| EPRI   | Electric Power Research Institute                      |
| ER-LTR | Energy Research Laboratory Technology Research Program |
| FEMP   | Federal Energy Management Program                      |
| FY     | Fiscal Year  |
| LBNL   | Ernest Orlando Lawrence Berkeley National Laboratory   |
| MDI    | Molecular Design Institute                             |
| NFRC   | National Fenestration Rating Council                   |
| NIH    | National Institutes of Health                          |
| PERS   | Public Employees Retirement System                     |
| UC     | University of California                               |
| UCOP   | University of California Office of the President       |
| UCRP   | University of California Retirement Plan               |



# I. Introduction

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In 1931, Professor Ernest O. Lawrence founded the research center that became Lawrence Berkeley National Laboratory. Today Berkeley Lab is recognized as a national research institution with over 60 years of groundbreaking work in the sciences. Located on 130 acres in the hills overlooking the UC Berkeley campus, the Lab has maintained close ties with the University of California, which manages it under contract with the U.S. Department of Energy (DOE).

Berkeley Lab is the oldest of the nine DOE national laboratories, and has had nine Nobel Prize winners on its research staff. The Lab is a research leader in the fields of energy, environment, materials, physics, chemistry, computing and communications, and biology and research medicine. Major research activities and centers currently include the Advanced Light Source, the Human Genome Center, the California Institute for Energy Efficiency, the Center for Advanced Materials, and the National Energy Research Scientific Computing Center.

Berkeley Lab presently operates on an annual budget of over \$340 million and employs over 3,300 people, including more than 1,000 scientists and engineers. Over 240 Berkeley Lab researchers also hold faculty appointments at either UC Berkeley, the UC San Francisco Medical Center, or other UC campuses. Berkeley Lab is helping to educate 400 students who are working at the Lab while pursuing their degrees. In addition, the Lab plays host each year to nearly 2000 guest researchers from the U.S. and abroad.

With a workforce of over 3,300, Berkeley Lab obviously has an important economic impact on Berkeley, the East Bay community, the greater Bay Area, and the nation. However, the Lab's total economic impact transcends the direct effects of payroll and purchasing. The direct dollars paid to the Lab's employees in the form of wages, salaries, and benefits, and payments made to contractors for goods and services, are re-spent by employees and contractors again and again in the local and greater economy. Further, while Berkeley Lab has secured its reputation for basic scientific research, many of the Lab's scientific discoveries and inventions have had direct application in industry, spawning new businesses and creating new opportunities for existing firms.



Berkeley Lab has undertaken this analysis in order to better define the economic and geographic impact of its expenditures. It is intended as a guide for state, local and national policy makers as well as local community members. Unless otherwise noted, this analysis uses data from federal Fiscal Year 1995 (FY95), the most recent year for which data is available. Whenever possible, the Lab attempted to verify all data by checking with alternative sources.

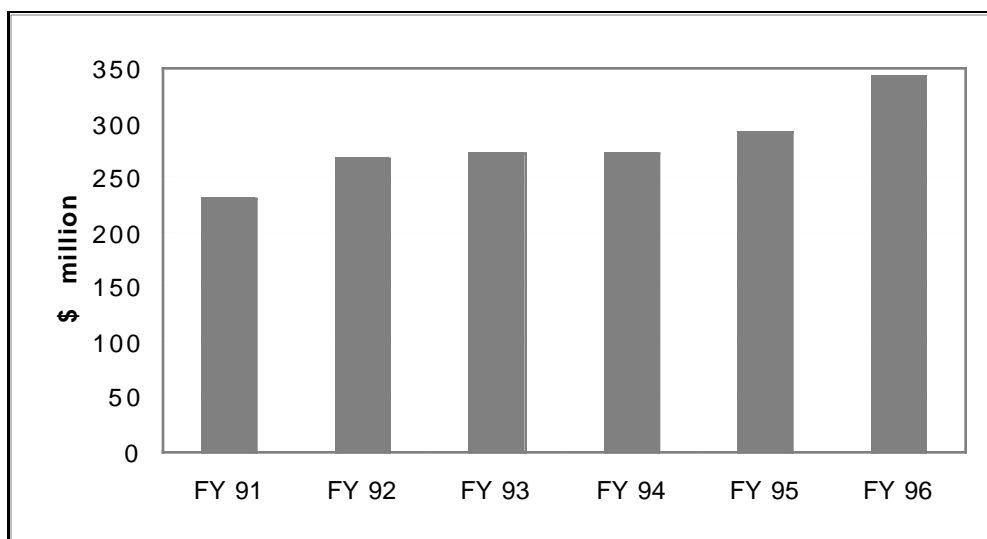
## II. Federal Fiscal Year 1995 Budget

### A. Revenues

During federal Fiscal Year 1995 (October 1, 1994, through September 30, 1995), Berkeley Lab's budget was \$292 million. Of this amount, DOE provided \$182 million of the Lab's operating budget and another \$69 million in construction and equipment funding. Altogether, DOE accounted for 86% of the Lab's revenue in FY95. The other major source of funding was the National Institutes of Health (NIH) at \$14 million (or 5% of total LBNL revenue), with the remaining \$27 million (or 10%) of Berkeley Lab funding garnered from various other government and industry sources.

Berkeley Lab funding has steadily increased in recent years (Figure 1). Previous fiscal years saw annual budgets of \$267 million in FY92, \$273 million in FY93, \$273 million in FY94, and \$292 million in FY95.

**Figure 1**  
**Total Revenue,**  
**FY91–96**

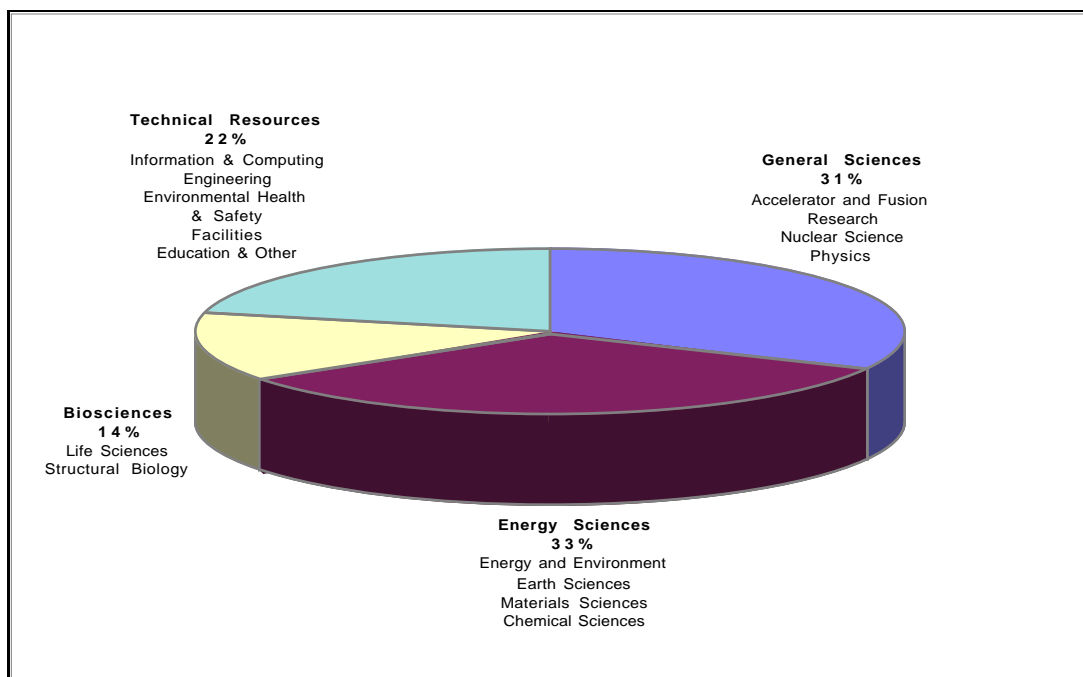


### B. Expenditures

For FY95, Berkeley Lab's funding was allocated to its major research areas in the following manner: general sciences, \$90.6 million (31%); energy sciences, \$98.0 million (33%); and biosciences, \$40.8 million (14%). The remainder of the annual budget was expended on technical resources, \$63.1 million (22%).<sup>1</sup> See Figure 2.

<sup>1</sup> Revenues and expenditures are not equal due to rounding and available sources of data. Cost data were used to determine revenue sources, and budget authority was used for expenditure distribution.

**Figure 2**  
**1995 Expenditures**



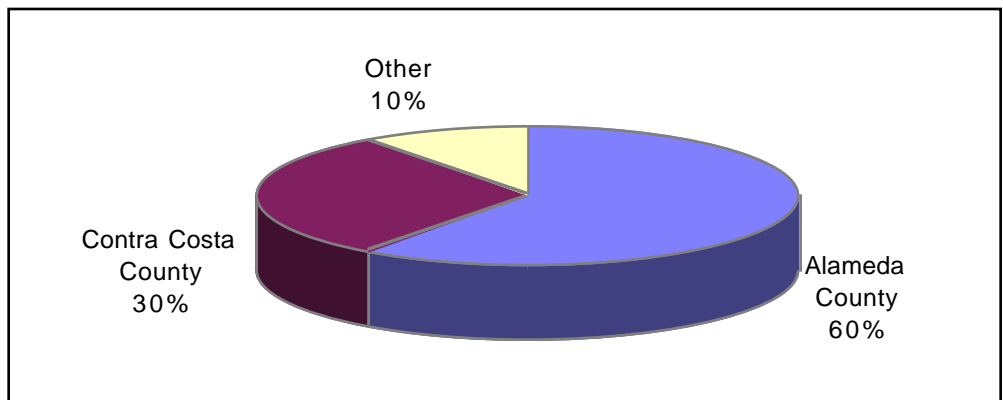
**Source:** Berkeley Lab Directorate, July 1996; *Report 1995*, Lawrence Berkeley National Laboratory.

### III. Direct Salaries and Benefits

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**A. Salaries and Wages** Berkeley Lab employs over 3,300 employees, 400 student employees, and 200 temporary contract workers, and each year hosts nearly 200 guest researchers. Most Berkeley Lab employees reside in the East Bay, with nearly 2,000 (60%) in Alameda County and over 1,000 (30%) in Contra Costa County (Figure 3). More than 1,000 (30%) Lab workers live in Berkeley, and approximately 450 (14%) live in Oakland.

**Figure 3**  
**Employee County**  
**of Residence**



During FY95, the Lab spent approximately \$137 million in salaries and wages. Of this amount, \$41 million (30%) went to employees living in Berkeley, with a total of \$71 million (52%) paid to Alameda County residents. Berkeley Lab is the second largest employer in Berkeley and the twelfth largest in Alameda County (Tables 1 and 2). It is estimated that a comparable amount, \$134 million, will be paid in salaries and wages in FY96.

Employees from Contra Costa County earned \$48 million, or 35% of total Laboratory salaries and wages. Altogether, Berkeley Lab directed \$119 million (or 87%) of its salary and wage payments to employees living in the East Bay.

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**Source:** Berkeley Lab Human Resources Department, July 1996.

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**Table 1**  
**Ten Largest Employers**  
**in Berkeley**

| Rank | Employer                                     |
|------|--|
| 1.   | University of California at Berkeley         |
| 2.   | <b>Lawrence Berkeley National Laboratory</b> |
| 3.   | Alta Bates/Herrick Hospital                  |
| 4.   | City of Berkeley                             |
| 5.   | Berkeley Unified School District             |
| 6.   | Miles Incorporated                           |
| 7.   | Associated Students of UCB                   |
| 8.   | Kaiser Foundation Hospitals                  |
| 9.   | Claremont Hotel Corporation                  |
| 10.  | Kaiser Permanente                            |

**Source:** City of Berkeley, Department of Community Development, July 1996.

**Table 2**  
**Fifteen Largest**  
**Employers**  
**in Alameda County**

| Rank | Employer                                     |
|------|--|
| 1.   | University of California at Berkeley         |
| 2.   | County of Alameda                            |
| 3.   | Kaiser Foundation/Permanente                 |
| 4.   | Lawrence Livermore National Laboratory       |
| 5.   | U.S. Navy <sup>2</sup>                       |
| 6.   | Oakland Public Schools                       |
| 7.   | U.S. Postal Service, Oakland District        |
| 8.   | City of Oakland                              |
| 9.   | New United Motor Manufacturing, Inc. (NUMMI) |
| 10.  | Safeway Incorporated                         |
| 11.  | Fremont United School District               |
| 12.  | <b>Lawrence Berkeley National Laboratory</b> |
| 13.  | Pacific Bell                                 |
| 14.  | Bay Area Rapid Transit                       |
| 15.  | Alta Bates Medical Center                    |

**Source:** County of Alameda, Economic Development Advisory Board, 1996.

## **B. Health Benefits and Workers' Compensation**

In addition to salaries, most Berkeley Lab workers are also compensated with employee benefits paid by the Lab.<sup>3</sup> These include health insurance (medical, dental, and vision), life insurance, and

<sup>2</sup> The U.S. Navy is closing its two major Alameda County facilities, Alameda Naval Air Station and Oak Knoll Naval Hospital.

<sup>3</sup> For this analysis, the Lab did not include the value of other employer-paid coverage, such as retirement, life, and disability insurance, and Social Security and Medicare taxes. Such benefits are not necessarily used during the same time frame, in the local economy, and/or in the same manner as salaries, health benefits, or Workers' Compensation.

disability insurance. During FY95, the Lab spent an estimated \$9.5 million on all forms of health benefits.

Berkeley Lab employees are also covered by a Workers' Compensation program in case of injury on the job. This program provides regular payments of a portion of an injured worker's lost wages, as well as medical expenses. The program also provides death benefits. All Workers' Compensation benefits are paid from a trust account administered by Applied Risk Management of Oakland. During FY95, it is estimated that the Lab spent \$2.5 million on its Workers' Compensation program.

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**Source:** Berkeley Lab Chief Financial Officer, July 1996.

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### **C. Retirement Benefit Payments**

After 65 years of research activity, Berkeley Lab has a large number of retirees. As of June 30, 1995, the Lab counted 1,504 living retirees who were receiving benefits from the University of California Retirement Plan (UCRP) or the California Public Employees Retirement System (PERS).

During FY94, 197 Berkeley Lab retirees and survivors received \$8.3 million in pension payments from PERS. Total retirement benefit payments greatly exceed this amount, but because those Berkeley Lab retirees receiving benefits from UCRP are grouped with pensioners from both UC Berkeley and the University of California Office of the President (UCOP), the pension payment total for the 1,307 other retirees is not available.

In addition to pension benefits, Berkeley Lab retirees receive health benefits paid through UCRP or PERS. These benefits include payment of medical and dental insurance premiums and, in some cases, reimbursement of Medicare Part B (medical insurance) premiums. During calendar year 1994, UCRP and PERS expended \$4.7 million on health benefit premiums for Berkeley Lab retirees.

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**Source:** University of California Retirement Plan, July 1995.

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## IV. Procurement

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**A. Goods and Services** During FY95, Berkeley Lab purchased nearly \$76 million in goods and services from commercial vendors. Of this amount, \$43 million, or 57%, went to small businesses. Small disadvantaged businesses comprised 12.3%, or \$9.3 million, of the Lab's total contracting amount. These amounts represent an increase over the previous fiscal year, and data available to date for Fiscal Year 1996 indicate further increases are expected.

In addition, Berkeley Lab purchased another \$20 million worth of goods and services from non-commercial vendors in FY95. These include the University of California, state and local governments, and non-profit organizations. During the current fiscal year, the Lab estimates that it will do business with 11,000 vendors.<sup>4</sup>

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**Source:** Berkeley Lab Procurement Department, July 1996.

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**B. Leases** One subset of goods and services purchased by Berkeley Lab is property leases for satellite offices. Presently, the Lab rents five properties, four in Berkeley and one in Washington, D.C. The four local leases are:

1. Building 903 (Warehouse)  
2700 Seventh Street  
Berkeley
2. Building 934 (DYMO Building)  
91 Bolivar Drive  
Berkeley
3. Building 936 (Hinks Building)  
2070 Allston Way  
Berkeley
4. Building 938 (Promenade Building)  
1936 University Avenue  
Berkeley

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<sup>4</sup> Berkeley Lab did not make any attempt to segregate procurement information the way it did salary and wage data to determine where these dollars are being spent. Such information, even if available, may be misleading. For example, contractors may list a sales office as a mailing address, while the contractor's actual work office and/or employees may be elsewhere. Further, contracted work may be distributed to other company work sites throughout the U.S. and even the world, especially with large companies. In addition, work may be subcontracted.



Altogether, Berkeley Lab expends over \$150,000 monthly on property leases in the city of Berkeley, or \$1.8 million per year.

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**Source:** Berkeley Lab Facilities Department, July 1996.

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## V. Other Direct Economic Impact

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### A. Conferences

Berkeley Lab hosts over 50 conferences a year. During FY95, 56 conferences were held, with over 2,800 conference guests visiting the Bay Area. Conference attendees and facilities users (see next paragraph) boost the local hospitality industry by an estimated \$400,000. For example: in June, 1996, the Lab hosted an educational event for local officials from cities all over the country (city council members and county supervisors) who assembled in Berkeley for a conference on Cities for Climate Protection.

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**Source:** Berkeley Lab Chief Financial Officer, July 1996.

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### B. National User Facilities

Berkeley Lab has developed and maintains four designated national user facilities on site: the Advanced Light Source, the National Center for Electron Microscopy, the 88-Inch Cyclotron, and the National Tritium Labeling Facility. These unique facilities are available for use by scientists from other universities, industry, and government. During FY95, 1,730 non-Lab researchers visited and used these facilities.

### C. Charitable Giving

Each year, Berkeley Lab employees participate in the Combined Federal Campaign (CFC) sponsored by the United Way. The Lab contributes over \$80,000 annually to local and national charities through the CFC.



# VI. Re-Spending Effects

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Dollars expended by Berkeley Lab do not stop creating economic opportunities upon payment to a Lab employee or contractor. This money is re-spent again and again in the economy, creating jobs and income for businesses and other workers. Many individuals not employed by the Lab and numerous businesses depend to some extent upon the ripple effects of Berkeley Lab spending for their livelihoods.

In order to estimate indirect and induced economic effects, Berkeley Lab utilized an economic multiplier analysis. With this type of analysis, a business or agency can theoretically determine the greater economic impact of its direct expenditures. Specifically, an input/output model of the nine-county San Francisco Bay Area developed by the Association of Bay Area Governments (ABAG) in 1987 and updated in 1995 was used. In this model, the Lab is classified as part of the non-commercial research and development sector.

To be conservative in the analysis, a number of areas—such as technology transfer, future capital projects, and qualitative economic impacts—was not included in the model. Some of these economic impacts will be described in more detail in subsequent sections of this report.

The following direct expenditures were included:

|                                   |                        |
|-----------------------------------|------------------------|
| Annual budget.....                | \$292.0 million        |
| (salaries, benefits, procurement) |                        |
| Retiree pension benefits.....     | 8.3 million            |
| Retiree medical benefits .....    | 4.7 million            |
| Guests.....                       | 47.0 million           |
| Conferences.....                  | 48.0 million           |
| <b>TOTAL.....</b>                 | <b>\$400.0 million</b> |

Using the ABAG input/output model, Berkeley Lab estimates that the total impact (direct, indirect, and induced effects) of Berkeley Lab spending on regional output is \$549 million on all sectors of the economy.

For regional income, the Lab's total impact is estimated to be \$210 million to \$430 million. Berkeley Lab's total impact on regional employment is estimated to be from 3,800 to 5,600 jobs.<sup>5</sup>

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**Source:** *1987 Regional Input-Output Model and Economic Multipliers for the San Francisco Bay Region*, March 1995, Association of Bay Area Governments.

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<sup>5</sup> Another conservative element in this study is that the multiplier analysis is based on sales data. As a government agency, Berkeley Lab does not have any sales per se. In lieu of sales, the Lab used cost data, which are expected to be lower than sales.

## VII. Science and Technology Partnerships

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*Federal support for R&D spawns ideas and insight and innovation that the private sector builds upon.*

—Laura D'Andrea Tyson

Chair of the President's Council of Economic Advisors

Berkeley Lab forms partnerships to share its advances in materials science, energy efficiency, health, environmental remediation, science education, and more. Technologies developed by the Lab have a positive impact on the U.S. economy. They have reduced energy costs and dependence on foreign oil, created businesses, and saved jobs.

In support of the DOE's mission to increase the nation's technological competitiveness, the Lab has in place numerous mechanisms to help link its research and resources to private industry. These mechanisms include:

- Technical assistance programs
- Work for others (sponsored research)
- Licensing agreements
- Cooperative Research and Development Agreements (CRADAs—cost-shared government-industry research projects)
- Personnel exchanges

### A. ER-LTR Program

Berkeley Lab's Energy Research Laboratory Technology Research Program (ER-LTR) was established to support the DOE's overall technology transfer program, which aims to enhance U.S. industrial competitiveness through mutually beneficial collaborations between national energy research laboratories and industry. The program's goal is to help bridge the gap between basic research endeavors (long-term, high-risk research) and commercial development (short-term, low-risk applications). ER-LTR partnerships include major projects such as the Lab's multifaceted work with the California semiconductor industry and our collaboration with the oil industry on the Advanced Computational Technology Initiative.

Over 90 ER-LTR projects have been funded with industrial partners such as Rockwell, Motorola, DuPont, Seagate, Chiron, Octree Corporation, Advanced Photonics, Mas Par, and Intel.

In a collaboration with Kaiser Permanente, a health maintenance organization, researchers at Berkeley Lab are helping to develop a network-based data management and communications system for storing, analyzing, and transmitting medical information, including images and data generated during medical procedures. By using a direct ATM network link between the imaging site and physician's office, Kaiser will be able to present real-time displays of medical procedures, and potentially allow on-line collaboration between a patient's physician and the operating physician in the laboratory.

Other partners include IBM, Siemens, Spectrum Sciences, and Bay Technical Products. DOE funding to date for these projects totals over \$25 million; combined industry and DOE commitments exceed \$65 million. Over half of the projects are with California companies.

#### **B. Work for Others**

Work for Others consists of sponsored research and development projects and technical assistance efforts that are fully funded by private industry or non-DOE government agencies. This work must use a unique capability of Berkeley Lab and not place it in competition with the private sector. The Lab annually receives in excess of \$40 million in sponsored research funding from non-DOE sponsors such as the National Institutes of Health, Amgen, Children's Hospital, and the U.S. Navy.

#### **C. Patents and Licensing of Lab Technologies**

Berkeley Lab seeks to patent and license its intellectual property to promote commercialization of its inventions, both for application by industry and to promote the research and technology transfer interests of the Lab and its research staff. The Lab filed 26 patent applications in Fiscal Year 1995, and 14 patents were issued; private companies licensed seven Berkeley Lab technologies.

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**Source:** Berkeley Lab Chief Financial Officer, July 1996.

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#### **D. Impact on Alameda County**

Partnerships between Berkeley Lab and companies in Alameda County help create jobs and have a positive effect on the county's economy. County partnerships include CRADAs with:

- Kaiser, Oakland
- Chiron, Emeryville
- Somatix, Alameda
- Wang NMR, Livermore

- Seagate Magnetics, Fremont
- Synchrodesign, Berkeley

Startup companies using Lab-developed technologies in Alameda County include PolyPlus of Berkeley, which was formed to market the Lab's solid-state lithium battery technology, and Morris Research, also of Berkeley, which sells high-transition-temperature (high  $T_c$ ) superconductivity instrumentation developed at Berkeley Lab. Startup companies in Alameda County using Lab-developed technologies project over \$20 million in sales revenue by 1998.

#### **E. The California Connection**

Berkeley Lab partnerships that impact California's economy go beyond the borders of Alameda County. Symyx of Sunnyvale, a startup company, licensed the Lab's method for combinatorial synthesis of materials; the agreement is expected to create 80 jobs at Symyx over the next four years. A company in San Diego uses a Lab-developed technology that can strengthen propeller blades or change the conductive properties on circuits. In a third case, using information provided by physicists from Berkeley Lab and other institutions, Contemporary Physics Education Design, a non-profit company in Portola Valley, produces educational materials on particle physics that include a chart and classroom activities packet.

Berkeley Lab hosts the California Institute for Energy Efficiency (CIEE), a research consortium of utility companies, universities, and research laboratories. Operating under terms of a multi-year, multi-million-dollar CRADA, its members include California's six largest electric and gas utilities, the California Public Utilities Commission, the University of California, the DOE, and the California Energy Commission. CIEE's mission is to identify, plan, and fund coordinated R&D on energy-efficient end-use technologies and to implement findings through successful technology transfer. R&D priorities are to improve building energy efficiency, improve air quality, and develop new performance monitoring techniques, data, and models for end-use resource planning. CIEE communicates the results of its R&D projects to potential users, including its sponsors, industry, government, and other research organizations.





## VIII. Impact of Energy Efficiency Programs and Partnerships

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### A. U.S. Impact

Since the mid-1970s, Berkeley Lab has developed several energy-efficiency technologies that have had an enormous economic impact on the nation. The Lab's research has produced new lighting sources, window coatings, and energy efficiency standards for appliances and housing. With a total research and development investment of \$70 million, the Lab estimates that consumers have already reduced their energy bills by \$5 billion as of 1993 because of these efforts. Further, already installed devices and equipment using this technology will continue to produce savings without additional capital costs.

Specifically, Berkeley Lab has developed four major tools for energy-efficiency: electronic ballasts for fluorescent lighting systems, energy-efficient window coatings, residential equipment and appliance efficiency standards, and building design/energy use software. New energy-saving technologies just now entering the marketplace are an advanced compact fluorescent bulb and the sulfur lamp, a new light source that is more efficient, longer-lasting, and environmentally safe than existing lighting sources. The sulfur lamp also provides better lighting than the best fluorescent light bulbs commercially available today.

Energy savings translate into environmental benefits through avoided emissions of carbon dioxide, sulfur dioxide, and nitrogen oxides from power plants. These technologies are being shared with other countries to assist in developing their own standards.

### B. California Impact

DOE-funded research at Berkeley Lab has identified an innovative way to reduce building cooling loads and improve comfort by using light-colored "cool" roofing, paint, and pavement materials. If applied on a neighborhood scale, these measures can noticeably reduce the summer "heat island" effect throughout an entire urban area and even reduce smog formation. California's South Coast Air Quality Management District and the Sacramento Municipal Utility District are developing plans to encourage the use of cool-surfaced roofs and pavement, as well as shade trees, in order to save on electricity bills and reduce summer smog.

DOE is participating in an interagency project to develop a master plan for energy-efficient renovations at the 800-building Presidio of San Francisco as the facility is converted to civilian uses. Berkeley Lab is helping to develop a Sustainable Development Institute at the Presidio in cooperation with the California Energy Commission.

Through the Lab, DOE has provided technical support to Pacific Gas & Electric Company's \$20 million Advanced Customer Technology Test (ACT<sup>2</sup>) program—the nation's largest demonstration of the maximum achievable level of energy efficiency in the design, construction, and retrofit of homes and commercial buildings.

DOE is a cosponsor of the California Institute for Energy Efficiency (CIEE), an innovative partnership with California's energy utilities, the California Energy Commission, the California Public Utility Commission, and the University of California. CIEE funds and coordinates a \$5 million annual research and technology transfer program, focusing on energy-efficient technologies of special interest to the state and region.

DOE supports Berkeley Lab in upgrading and maintaining DOE-2, the state-of-the-art whole-building energy analysis computer code. Southern California Edison, Pacific Gas & Electric Company, and the Electric Power Research Institute (EPRI) have recently co-sponsored advanced versions of DOE-2 with DOE. These advanced versions will be used nationwide as well as in California. The just-released version DOE-2.1E can simulate a wide variety of advanced HVAC systems such as desiccant cooling and variable-speed heat pumps. Under development is PowerDOE, an easy-to-use version of DOE-2 with graphical interfaces and links to other building design tools such as CAD systems.

Southwall Technologies is a \$23 million per year California company whose high-efficiency glass and window products set performance standards for buildings worldwide. The company attributes much of its success to its close links to the DOE-supported research on advanced window technologies at Berkeley Lab.

DOE-supported research at the Lab on the thermal and optical performance of fixtures for compact fluorescent lamps has led to more energy-efficient products marketed by the California firms Delray Lighting and Lumatech Corporation, as well as firms in other states. San Diego Gas & Electric Company credits these improvements with significant energy savings for its 1 million customers, greater consumer acceptance of compact fluorescents, longer lamp life, and energy resource conservation.

The California Energy Commission, DOE-supported researchers at Berkeley Lab, and EPRI jointly produced the Advanced Lighting Guidelines—the seminal document on emerging energy-efficient lighting technologies. The guidelines are used extensively in the Federal Energy Management Program’s (FEMP’s) training programs.

DOE-supported research at Berkeley Lab on window thermal and optical performance provides much of the technical basis for window ratings by the National Fenestration Rating Council (NFRC), a voluntary manufacturers’ group. California energy conservation requirements were one of the key motivators in the formation of NFRC. The ratings are referenced in the California building energy conservation code and are intended to provide uniformity among state requirements on window systems, an important issue to a nationwide but highly diverse and fragmented window industry. In the longer term, the ratings should help consumers evaluate energy efficiency along with other window features on an economic basis—a development that is expected to increase the sales of more energy-efficient windows in preference to inefficient ones that have lower first costs but are more expensive over the long term.

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**Source:** *From the Lab to the Marketplace: Making America’s Buildings More Energy Efficient*, Lawrence Berkeley National Laboratory/DOE.

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## IX. Qualitative Impact

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As demonstrated so far, Berkeley Lab has a significant economic impact on Berkeley, the East Bay, and beyond. But not every Berkeley Lab impact can be boiled down to dollars and cents—nor would we necessarily want it to. In this section, the Lab reviews a number of community outreach efforts in which it is involved.

### A. Education

Berkeley Lab is involved with and committed to the education of the community's and nation's young people. On average, 400 college students from UC Berkeley are employed at the Lab while they are working toward their degrees. In addition, over 240 of the Lab's scientific staff are on the UC faculty.

Each summer, Berkeley Lab's Center for Science and Engineering Education (CSEE) conducts its Summer Laboratory Research Fellowship program for undergraduates. During 1995, the program had 51 students from the U.S. and three international students participating in 10-week fellowships. For undergraduates, the exposure to and involvement in cutting-edge scientific research is a unique and invaluable experience.

At the elementary and secondary school level, Berkeley Lab is also involved in a number educational outreach efforts. Last summer, 20 Bay Area high school students participated in the Lab's Student Research Program, which targets juniors and seniors from populations underrepresented in the sciences for an eight-week internship at the Lab. CSEE also sponsors a regional Science Bowl each spring. The winning team travels to Washington, D.C. to participate in the National Science Bowl.

CSEE also provides training to local teachers of mathematics and science. Berkeley is active in DOE's Teacher Research Associates Program. During the summer, 20 to 40 high school teachers earn the opportunity to work alongside Berkeley Lab scientists. This program provides teachers with research experience, better enabling them to teach science at the high school level.

### B. Shuttle Bus Service

Berkeley Lab Bus Service provides transportation between buildings on site as well as to the UC Berkeley campus, downtown Berkeley, and the Rockridge BART. During the work day, buses on most routes are 10 minutes apart. The buses carry 500,000 passengers per year,

with 102 on-site and 77 off-site trips per day. During 1995, the Lab's shuttle bus system received a \$525,000 grant from the Bay Area Air Quality Management District (BAAQMD) to reduce air pollution over the next two years.

### **C. Volunteerism**

Laboratory employees volunteer substantial amounts of time to activities that benefit the local community. Just a few of the organizations that have Berkeley Lab employee participation are:

- Chabot Science Center
- Berkeley Chamber of Commerce
- Alameda County Economic Development Advisory Board
- Bay Area Defense Conversion Action Team
- Bay Area Economic Forum
- Bay Area Regional Technology Alliance
- Oakland Metropolitan Chamber of Commerce
- Tutoring in local schools
- Berkeley Travel Reduction Program (TRIP)
- Speakers Bureau

## X. Select Bibliography

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